HIGH SPEED NON-DESTRUCTIVE RAIL TESTING WITH ADVANCED ULTRASOUND AND EDDY-CURRENT TECHNIQUES

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Wheel rail fatigue
Head Checks
Probe Arrangement for SPZ1

UT-Probes and ET-Sensors
Normal beam probe: $c_L = 5920 \text{ m/s;} \ \alpha = 0^\circ; s = 172 \text{ mm} \Rightarrow T \approx 60 \mu\text{s}$

Angle beam probe (45°): $c_T = 3255 \text{ m/s;} \ \alpha = 45^\circ; s = 250 \text{ mm} \Rightarrow T \approx 185 \mu\text{s}$

Additional delays in probe, cables, data acquisition, etc...

$f_{\text{max}} < 5 \text{ kHz}$
Repetition Rate Limits Testing Speed

lateral resolution < 3 mm
repetition rate = 5 kHz

Number of single detections with ultrasound vs. Testing speed [km/h]

recognition level
Combined Gate- and A-Scan Techniques:

- 4 gates (echo height and echo position)
- 1 A-scan (3 mm resolution)
- 4.6 kHz repetition rate
- 20 test functions
- 22 MByte data per second for UT testing
Example: Ultrasonic Data from Rail Track

Zoom Area 1000 m = 21 MByte

Zoom Area 10 m = 213 kByte

Zoom Area 20 cm = 4 kByte
Sizing of Indications

Overall resolution: 3 mm
System Setup

UT-LEFT

UT-DEV 1

ET-LEFT

ET-DEV 1

UT-DEV 2

ET-Master

ET-DEV 2

ET-RIGHT

UT-Master

UT-DEV 3

UT-RIGHT

UT-DEV 4

GPS

Clock

Marker

System Setup
Data Processing and Data Analysis

Cluster

Data

Harddisk Network

Criteria

Neuronal Network

Pattern

Fuzzy Logik

Result

Pattern:
- 
- 
+ 
+

Data Processing and Data Analysis
Example 1: Thermite Weld

Indication from the weld

Indication from the bead

Speed 60 km/h
Example 2: Fishplate Junction

Indications from the drillings

Indication from the joint
Example 3: SQUAT

Diagnosis:
SQUAT with small crack
Probes and Probe Shoes
Practical Experiences at 80 km/h

Swung away
Snapped off
Ruined
Torn off
Rubbed away

BAM DB
• 10 UT probes and 4 ET probes per rail
• Lateral resolution of 3 mm independent from testing speed
• Allocation of indications by means of GPS data
  Maximum impreciseness of indications position
• Online monitoring of testing sensitivity
• „Glassy Rail Diagram“
• Optimized data analysis based on neuronal network and fuzzy logic
• More than 9 months of stable and controlled operation
Thank you for your attention!

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